

Treatment of Poliomyelitis with Involvement of the Respiratory System

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SUMMARY

The mortality rate of poliomyelitis may be reduced by early measures to prevent anoxia and its subsequent complications.

Constant nursing care, early tracheotomy, the giving of oxygen, proper use of the respirator and positive pressure equipment are essential in the proper management of patients with poliomyelitis who have respiratory involvement.

THE management of the patient who has poliomyelitis and interference with respiration offers a challenge to the clinician. It is from this group of patients that the mortality rate for this disease is derived. If lives are to be saved, life-saving procedures must be instituted early in the course of the disease. Treatment must be directed toward prevention of fatal complications.

Successful management in such cases requires teamwork by experienced personnel and availability of adequate equipment and facilities. The burden of patient care rests with the nursing staff and they must be instructed in the newer approach to treatment and what they are expected to do.

Complications which most often prove fatal are prolonged anoxia, atelectasis, pulmonary edema and disturbance of blood electrolytes and serum proteins. Treatment must be such as to prevent or to correct these complications as they develop. The cause of anoxia should be determined and, if possible, corrected. Prevention of anoxia may be accomplished in many instances by the early performance of tracheotomy and use of the respirator.

Information presented herein is based on observations of more than 6,000 patients with poliomyelitis treated at the Los Angeles County General Hospital in the four-year period 1946-1949. Tracheotomy was done in 357 cases. Use of a respirator was required in 495 cases.

Indications for tracheotomy are (1) occlusion or impending occlusion of the airway due to secretional obstruction, which is aggravated by the inability of the patient to swallow, cough or maintain a free airway, and paralysis or spasm of the vocal

cords; (2) massive atelectasis; (3) development of respiratory symptoms requiring a respirator, in a patient previously able to void the secretion of mucus; in such patients the intrathoracic negative pressure increases due to the partially obstructed airway, and mucus then is sucked into the lower bronchial tree, causing plugging and atelectasis; (4) persistence of cyanosis in spite of what seems to be adequate respiratory exchange; and (5) physical resistance by the patient to the aspiration of mucus from the respiratory tract.

Advantages of tracheotomy are as follows: (1) A clear airway is assured. (2) Suction and bronchoscopy may be performed easily. The cooperation of the patient for such procedures is not required. (3) Positive pressure may be readily applied for improvement of ventilation, prevention of pulmonary edema and atelectasis. (4) For many patients it has proven to be a life-saving measure.

Early tracheotomy is stressed. If the procedure is performed before any emergency sets in, bronchoscopy may be carried out, mucus or plugs removed, oxygen supplied through the bronchoscope tube and a more leisurely operation performed over the tube. This is urged in the performance of tracheotomy on all patients but particularly children. The incidence of pneumothorax and subcutaneous emphysema will be reduced.

The Bennett flow-sensitive intermittent positive pressure unit is of great value in the performance of tracheotomy on the patient who requires respiratory assistance. The patient is assured adequate ventilation throughout the entire procedure. If he is capable of initiating or maintaining his own breathing, this machine offers no interference.

A high tracheotomy is preferred. The trachea should be entered at the level of the second tracheal ring. It may be necessary to sever the isthmus of the thyroid. Bleeding should be anticipated and adequately controlled. High tracheotomy simplifies subsequent nursing care for the respirator patient. It is wise to use the largest tracheotomy tube compatible with the diameter of the trachea. However, the tube should not reach the bifurcation of the trachea.

To prevent complications due to electrolyte imbalance it is necessary to obtain blood sodium, chloride, carbon dioxide, potassium and pH determinations. The blood pH is of the utmost importance. It is the best way to distinguish between respiratory acidosis and true alkalosis. In both conditions the carbon dioxide combining power is elevated. However, if the blood pH is low the conditions should not be confused. The treatment for respiratory acidosis is improvement of ventilation.

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Gastric suction with removal of chlorides, and the injudicious use of sodium, may cause alkalosis in some cases. The treatment of this condition is the intravenous administration of ammonium chloride and normal saline.

Total proteins may be reduced and the albumin-globulin ratio often is reversed. Administration of plasma intravenously is the treatment of choice.

If the patient has some degree of interference with respiration but a respirator is not needed, the following program may prove beneficial. (The program entails 24-hour nursing care and availability at the bedside of all necessary equipment for the care of each patient.)

Oxygen, when indicated, should be administered by nasal catheter if the patient does not have a tracheotomy. If the patient is tracheotomized there should be an adapter to connect the oxygen catheter with the opening in the tracheotomy tube. This is very important in the case of small children for whom a No. 2 or No. 3 tracheotomy tube is used, because if the catheter were to be inserted into the tube, it would further occlude the airway and impair exhalation. In such circumstances pulmonary acidosis would be liable to develop. If a larger tube is used, a small catheter may be inserted into it.

Mucus may be removed from the trachea and bronchial tree by gentle suction through the tracheotomy tube. Prior to suctioning, a few drops of normal saline solution containing 200 units of penicillin per cc. may be instilled into the tracheotomy tube. The suction catheter should be small enough to pass through the tracheotomy tube without undue force. The tip of the catheter should be rounded. The tracheotomy inner tube should be removed frequently and thoroughly cleansed.

In order to facilitate drainage of mucus, the patient may be placed in a steep Trendelenburg position at regular intervals. However, constant use of this position should be avoided as the weight of the abdominal viscera against the diaphragm might further embarrass respiration and reduce cardiac output.

It is wise to pass a Levine tube at the start of treatment. Wangenstein suction apparatus should be at hand. Acute gastric distention is common, and immediate emptying of the stomach may be a life-saving measure. Vomiting, aspiration of vomitus and occlusion of the airway may occur.

Diet: Although the patient may be critically ill, if extreme care is used a formula may be fed by continuous drip through the Levine tube. The formula should be high in protein and carbohydrate, low in fat, with essential amino acids, vitamins and potassium added. At the first sign of gastric or abdominal distention, feeding should be temporarily discontinued. The diet should be a supplement to fluids, plasma and whole blood given intravenously. As the patient improves, more calories may be given either orally or by Levine tube, depending on ability to swallow.

Pain due to muscle spasm is best controlled by use of acetylsalicylic acid and hot packs. If the pain is severe, Intocostin® (curare extract) may be used. The results are usually excellent if adequate dosage is given.

If headache persists, spinal puncture frequently gives relief, even in those patients with low spinal fluid pressure. Headache may be due to anoxia and in such cases supplemental oxygen may give prompt relief. Sedation should be avoided, particularly with drugs known to embarrass respiration.

Fever may be controlled by acetylsalicylic acid (given through the Levine tube or by rectum). When the patient is critically ill and the temperature high, hot packs should not be used. It is more important that the patient be allowed to rest than to be subjected to such a fatiguing and disturbing procedure. If there is sufficient spasm of the intercostal muscles and diaphragm to embarrass respiration, Intocostin® and hot, light compresses should be used.

The pulse and blood pressure should be checked frequently and the patient observed for any change in respiration. A respiratory ventilation meter for the measurement of tidal ventilation has been developed recently. Frequent use of this instrument helps to determine when a respirator is indicated. However, clinical experience alone will generally enable one to determine when patients need assistance.

To combat secondary infection, penicillin in routine dosage should be given to patients who are tracheotomized or who have involvement of the muscles of respiration. If the patient is unable to void urine, catheterization should be done when necessary. In-dwelling catheters are occasionally necessary.

Abdominal distention is treated by Wangenstein suction, rectal tube, neostigmine, and hot compresses.

When the patient's condition is no longer critical a program of physical therapy should be instituted.

CARE OF THE RESPIRATOR PATIENT

If signs of anoxia develop in a patient with a clear airway, a respirator should be used. Mechanical assistance is not contraindicated in the treatment of bulbar poliomyelitis. Pulmonary edema is liable to supervene without warning if clinical cyanosis is allowed to develop. Often the first signs of anoxia are headache, increase in the pulse rate, sweating of the forehead, restlessness and anxiety. Irreparable damage to the central nervous system may be prevented if the patient is offered respiratory assistance prior to becoming irrational and semi-comatose.

Before placing the patient in a respirator, if a tracheotomy has not been performed, the advantages should be considered and a decision reached. With adequate equipment and help it may be performed later. However, to avoid emergency procedures is a step toward saving lives. The patient should be told why a respirator is necessary and instructed as to how to breathe with the machine.

NEW EQUIPMENT

To prevent complications which in the past have proved fatal to the respirator patient, new equipment was devised at the Los Angeles County General Hospital. This equipment consists of a positive pressure attachment which operates by means of a small bellows in synchronization with the respirator. When the respirator is in a negative cycle the positive pressure unit is in a positive cycle. Air is forced under pressure through the tracheotomy tube.

This is important in overcoming the increase in intrathoracic negative pressure due to the partially occluded airway. Better ventilation is obtained. Because of the action of the expiratory valve the patient is not required to breathe out against any resistance other than that offered by the tracheotomy tube. Respiratory acidosis, atelectasis and pulmonary edema are reduced to a minimum. Air, oxygen or oxygen and helium may be administered directly into the unit. Humidification of the gases is important. There is an air filter to reduce the hazard of infection of the trachea due to contaminated room air.

In order to improve the respiratory pattern of the respirator, a cam was developed. The cam makes possible a slow, uniform inspiratory pressure rise and a rapid expiratory flow simulating the pattern of normal respiration. Chest pain presumably due to an increase in intrathoracic negative pressure has been eliminated. Adequate ventilation can be obtained with lower pressure settings than were used previously. Thus, tidal ventilation is increased by combination of the positive pressure unit and the cam. The equipment is a valuable adjunct to the management of the tracheotomized patient who requires a respirator. It should be employed as soon as the patient is in the respirator. Its use allows time to make all the necessary adjustments without undue haste.

If the patient is unable to synchronize with the respirator, hot packs should be placed against the chest and Intocostrin® should be given. Several doses of the drug may be required. If the patient's inability to synchronize with the respirator is due to pulmonary acidosis, positive pressure will correct this incompatibility.

As soon as the patient is adapted to the respirator, routine procedures may be carried out. It is important that pressure points be well padded. The collar should not cause the patient any discomfort and it should be pushed well into the respirator by a metal shield to allow adequate room for the care of the tracheotomy tube.

During the first few days in the respirator, most attention should be directed toward keeping the patient alive. Care of the patient's body should be reduced to a minimum. To keep the airway free, removal of mucus may require the full attention of a nurse. If the patient is to be saved it becomes a matter of 24-hour nursing care, properly functioning equipment, and fluid balance.

A common error is neglecting to remove mucus from the main bronchi by suction. A clear upper

airway does not mean that the main bronchi are free of mucus. Accumulation of mucus leads to anoxia and its complications. Nurses must understand the importance of maintaining a free airway. If cyanosis persists after proper suctioning, bronchoscopy should be performed.

Rules governing the feeding of the non-respirator patient apply equally well to the patient in a respirator. Gastric distention is more common and it is often necessary to use Wangenstein suction. However, the importance of maintaining normal protein values is well established and it is advisable to feed the critically ill patient. When food is offered by mouth, the diet should be appetizing, non gas-forming and highly nutritious. The difficulty connected with swallowing due to the action of the respirator requires that adequate time be allowed to feed the patient properly.

Plasma, whole blood and other fluids should be given as indicated. It is important to carry out blood chemistry determinations at regular intervals. Blood pressure should be checked frequently. Periodic x-ray films of the chest blood cell count, urinalysis and culture of blood should be obtained periodically. If positive pressure is available the purely mechanical difficulty of obtaining the specimens is reduced to a minimum.

Mechanical accidents occur. The best safeguard is to know what might happen and to take steps to prevent it. By far the most common accident is a leak at the collar, permitting the respirator pressure to fall. Respirator ports may be left open, or they may work loose. A reliable warning device connected with the respirator is desirable. If positive pressure is being used, death may be avoided but such an accident always causes the patient considerable anxiety and increases the demands made on the nursing staff.

The patient may need *constant* supplemental oxygen. Oxygen tanks should not be permitted to become empty. The oxygen gauge should be turned toward the nurse.

Suction machines should be in good working order. An adequate supply of suction catheters should be at hand, as they are easily contaminated.

It is important to change the tracheotomy tube at frequent intervals. However, it should not be removed during the first 24 to 36 hours. It may be exceedingly difficult to replace before a track is established.

The speed of the respirator must be watched. The ideal speed is that which assures the patient adequate ventilation without producing hyperventilation syndrome. With positive pressure and the cam, adequate tidal air is obtained at fairly low pressure settings. The proper pressure may be determined by frequent use of the respiratory ventilation meter. A tidal ventilation of 400 to 600 cc. is adequate.

To aid in drainage of mucus, the respirator may be tilted. However, the Trendelenburg position must not be used over a prolonged period. When the position of the respirator is changed, examination

for possible pressure leaks should be made. It is important that the patient's collar does not impede circulation.

In order to withdraw the patient from the respirator and to carry out proper nursing procedures, positive pressure equipment should be used to maintain adequate ventilation. This equipment also permits packing the patient and starting physical therapy at an early date.

There are many complications common to the respirator patient which require early detection and careful management. Pneumonia and infections of the urinary tract are common. Treatment depends upon the causative organism. Decubitus ulcers are a problem. Air mattresses, frequent changing of the patient's position and maintenance of normal protein values are of help. Sinusitis may develop due to the disturbance of the nasal passages by frequent suction and the presence of a Levine tube. This condition may be reduced to a minimum by frequent changing of the tube, nasal shrinkage and topical application of antibiotics. Infections of the trachea secondary to tracheotomy and trauma, due to suction catheters, are frequent. A common offender is *Pseudomonas aeruginosa*. The most efficacious treatment has proven to be sulfonamides and streptomycin. Bacteremia due to the previously mentioned organism and occasionally *E. coli*, may occur. Streptomycin, aureomycin and chloramphenicol are the drugs of choice in the treatment of this complication. Hypertension may develop, the cause of which is usually obscure. Psychiatric problems arise. It is urged that a psychiatrist be in attendance to direct proper treatment.

Every encouragement possible is given the patient. Immediate members of the family are constantly warned against doing or saying anything which might conceivably upset the patient. Morale is an important factor in recovery.

A sincere attempt should be made to segregate the new, acutely ill patient from others who have the first few days of their illness behind them. The possibility of secondary respiratory infection must be guarded against. Penicillin should be used routinely in adequate dosage.

Patients should be removed from the respirator as soon as possible. However, it is a mistake to attempt to remove a patient from a respirator if the respiratory exchange is inadequate. This leads to disaster. By frequent use of the respiratory ventilation meter this error may be avoided.

The rocking bed, which is relatively new in the treatment of poliomyelitis, will undoubtedly contribute to satisfactory early removal of patients from the respirator. However, experience gained by limited use of this equipment indicates that care should be taken that the patient has adequate ventilation before the bed is used. It may give the necessary assistance to borderline patients and permit good physical therapy at an early date. Perhaps the rocking bed will be the answer to the so-called respirator-fast patient. Experience will determine the answer.

Before attempt is made to remove the tracheotomy tube, the patient should be able to get along without supplemental oxygen. If this is accomplished over a period of days, a small tracheotomy tube may be substituted for the larger one and be closed off. If, in a matter of two or three weeks, the patient has not required suctioning through the tracheotomy tube, it may be removed. Positive pressure may be administered by mask in order to continue adequate nursing care and physical therapy. If a condition arises which impairs the patient's ventilation, another tracheotomy should be carried out without hesitation.

In the management of the respirator patient, it is extremely important that physicians and nurses secure the patient's confidence.